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YUCCA MOUNTAIN - REQUEST FOR ADDITIONAL INFORMATION (RAI) – VOLUME 2,
CHAPTER 2.1.1.7, SET 6 (DEPARTMENT OF ENERGY’S SAFETY ANALYSIS REPORT
SECTIONS 1.2.3, 1.2.4, 1.2.5, 1.2.6, 1.2.8, 1.3.3, 1.4.1 and 1.4.2) – Design of SSCs Electrical

Reference: Ltr, Jacobs to Williams, dtd 5/5/09, “Yucca Mountain - Request for Additional
Information – Volume 2, Chapter 2.1.1.7, Set 6 (Department of Energy’s Safety
Analysis Report Section 1.2.3, 1.2.4, 1.2.5, 1.2.6, 1.2.8, 1.3.3, 1.4.1, and 1.4.2)”

The purpose of this letter is to transmit the U.S. Department of Energy’s (DOE) responses to nine
RAI’s identified in the above referenced letter regarding DOE’s SAR Sections 1.2.3, 1.2.4, 1.2.5,
1.2.6, 1.2.8, 1.3.3, 1.4.1, and 1.4.2 pertaining to electric power. The Nuclear Regulatory
Commission’s (NRC) requests correspond to NRC’s Safety Evaluation Report, Volume 2,
Chapter 2.1.1.7, *Design of SSCs*. Each RAI response is provided as a separate enclosure.

There are no commitments made in the enclosed RAI responses. If you have any questions
regarding this letter, please contact me at (202) 586-9620, or by email to
jeff.williams@hq.doe.gov.

Jeffrey R. Williams, Supervisor
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OTM:SAB-0780

Enclosures (9):
Responses to Four Requests for Additional Information
Volume 2, 2.1.1.7-1 through 2.1.1.7-9, Set 6



cc w/encls:

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EIE Document Components:

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RAI Volume 2 Chapter 2.1.1.7, Sixth Set, Number 1:

The following questions pertain to DOE's design of the important-to-safety (ITS) Electric Power described in SAR Section 1.4.1. The ITS electric power supply is relied on for safety functions of structures, systems, and components, described in SAR Sections 1.2.3, 1.2.4, 1.2.5, 1.2.6, 1.2.8, 1.3.3, 1.4.1, and 1.4.2. The information requested below is needed to verify compliance with 10 CFR 63.112(f).

Justify the basis for the probability of loss of offsite power (LOSP) used in the Table 1.4.1-1.

The applicant used a probability of LOSP that appears to be based on general historical data for frequency of LOSP experienced in the United States in general, rather than more specific experience available for the Western Region, where the repository is to be located.

1. RESPONSE

SAR Table 1.4.1-1 lists preclosure nuclear safety design bases and their relationship to design criteria for the important to safety (ITS) electrical power systems. The probabilities shown in Table 1.4.1-1 are conditioned on the occurrence of a loss of offsite power. The loss of offsite power frequency is, therefore, not an input into the values in SAR Table 1.4.1-1. The design basis probabilities in SAR Table 1.4.1-1 are conditioned on loss of power because the ITS diesel generators, associated ITS electrical distribution, and the associated ITS nonconfinement cooling systems are required if a loss of power occurs. In these cases, each design basis shown in the table establishes the required reliability of the engineered structures, systems, and components that are needed for ITS confinement, heating, ventilation, and air-conditioning after a loss of power. The design basis for these components does not establish or use a frequency of loss of offsite power. For example, design bases identifiers EE.CR.02 and EE.WH.03 in SAR Table 1.4.1-1 correspond to the identical identifiers in the Canister Receipt and Closure Facility (CRCF) nuclear safety design basis in SAR Table 1.9-3 and Wet Handling Facility (WHF) nuclear safety design basis in SAR Table 1.9-4, respectively. These identifiers indicate that the mean conditional probability for ITS electrical power failure, given the loss of offsite power, shall be less than or equal to 3×10^{-1} over a period of 720 hours following a radionuclide release. The fault tree models supporting these design bases do not use a probability of loss of offsite power to establish the value of 3×10^{-1} over a period of 720 hours.

However, in other parts of the preclosure safety analysis (PCSA) (e.g., the ITS heating, ventilation, and air-conditioning fault tree), the loss of offsite power frequency was used and derived from national data from NUREG/CR-6890, *Reevaluation of Station Blackout Risks at Nuclear Power Plants* (Eide et al. 2005). Use of national data as opposed to western regional data is more representative of future performance, as expressed by the authors of NUREG/CR-6890 (Eide et al. 2005, p. 21, emphasis added):

Regional results are presented in Table 3-6 for the NERC reliability councils. Grid-related frequencies for these councils range from a low of $2.0E^{-3}/\text{rcry}$ for the Southeastern Electric Reliability Council (SERC) to a high of $6.4E^{-2}/\text{rcry}$ for the Northeastern Power Coordinating Council (NPCC). However, all six of the NPCC events and both of the East Central Area Reliability Coordination Agreement (ECAR) Council events are the result of the August 14, 2003, grid disturbance event. Although these reliability council frequency estimates for grid-related LOOPs are indicative of recent past performance, *the dominance of one event indicates that the frequency estimates may not be representative of future performance.*

While this statement did not directly address the western region data, the same dominance by a single event applies in the western region.

Specifically, Table 3-6 of NUREG/CR-6890 (Eide et al. 2005) identifies only three grid-related loss of offsite power events during 57 critical years of operation for the Western Electricity Coordinating Council, the region in which Yucca Mountain is located. For the entire country, NUREG/CR-6890 (Eide et al. 2005) identifies 13 events over 724.3 cumulative critical years of operation of nuclear power reactors in the United States.

Closer examination of the three events identified for the Western Electricity Coordinating Council reveals that they resulted from a single grid-related loss of power occurrence at the Palo Verde Nuclear Power Plant on June 14, 2006 that affected all three units and was reported separately for each unit (Eide et al. 2005, Appendix A).

The use of national data regarding loss of offsite power frequency was deemed to be more representative of future performance than the western regional data. However, the loss of offsite power frequency was not used to justify the basis for probability of the loss of offsite power in SAR Table 1.4.1-1.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

Eide, S.A.; Gentillon, C.D.; Wierman, T.E.; and Rasmuson, D.M. 2005. *Analysis of Loss of Offsite Power Events: 1986-2004. Volume 1 of Reevaluation of Station Blackout Risk at Nuclear Power Plants*. NUREG/CR-6890. Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20071114.0164.

RAI Volume 2, Chapter 2.1.1.7, Sixth Set, Number 2:

The following questions pertain to DOE's design of the important-to-safety (ITS) Electric Power described in SAR Section 1.4.1. The ITS electric power supply is relied on for safety functions of structures, systems, and components, described in SAR Sections 1.2.3, 1.2.4, 1.2.5, 1.2.6, 1.2.8, 1.3.3, 1.4.1, and 1.4.2. The information requested below is needed to verify compliance with 10 CFR 63.112(f).

Provide information on the criteria for selecting the extent of voltage degradation that would initiate the start-up of the ITS emergency diesel generators (EDGs) (SAR Section 1.4.1.2.1, page 1.4.1-8) and how the criteria relates to historical LOSP data in RAI # 1.

The applicant states in SAR section 1.4.1.2.1 that the ITS EDGs start automatically upon sensing LOSP by sensing low voltage or degraded voltage. However, the criteria for determination of low or degraded voltage or the respective thresholds at which the offsite power will be disconnected from ITS Trains A & B and the ITS EDGs will be started and sequenced to connect to ITS loads have not been provided.

1. RESPONSE

The onsite important to safety (ITS) power subsystem is designed in accordance with IEEE Std 308-2001, *Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations*, and the guidance provided in Regulatory Guide 1.6, *Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems*. In addition, the ITS electric power equipment is protected in accordance with IEEE Std 741-1997, *IEEE Standard Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations*. The use of the above IEEE standards is limited to features that are applicable to the repository.

The design criteria, IEEE Std 308-2001 and IEEE Std 741-1997, used for selecting the extent of voltage degradation to initiate the start-up of the ITS diesel generators, are listed in SAR Section 1.4.1.2.8, *Design Codes and Standards for AC and DC ITS Electrical Power*. ITS diesel generators start automatically on the loss of voltage, undervoltage, or degraded voltage to the respective 13.8 kV ITS bus to which each ITS diesel generator is connected. Each ITS diesel generator may be started manually by a switch located in the associated ITS diesel generator switchgear room (Rooms 1002 and 1012).

Specifically, Section 4.1.4 of IEEE Std 308-2001, *Protection*, states that protective devices shall be provided to limit the degradation of the Class 1E power systems below an acceptable level, in accordance with IEEE Std 741-1997. IEEE Std 741-1997, Section 5.1, *AC Power Distribution Systems*, and Annex A, *Illustration of Concepts Associated with Degraded Voltage Protection*, provide the principal design criteria and philosophy for selecting voltage degradation set points.

The respective thresholds at which the offsite power will be disconnected from ITS Trains A and B and start the ITS diesel generators will be determined in accordance with IEEE Std 741-1997 as applied to ITS, rather than Class 1E, equipment. Annex A of IEEE Std 741-1997 states:

Determining the set point for degraded voltage relays usually requires a detailed analytical basis because the set-point value is the result of a balance between preventing damage to Class 1E equipment and unavailability of Class 1E equipment. This must be achieved in a manner that avoids nuisance trips of the relay and resultant starts of the diesel generators due to an overly conservative set point.

Given the detailed equipment information required to determine set-points for degraded voltage relays, an analysis to determine these set points will be performed during detail design. Additionally, to minimize the effects of relay chatter and nuisance trips, the control relays (ITS and non-ITS) within the Emergency Diesel Generator Facility are solid state (static) or meet the standards set forth in NUREG/CR-5499, *Guidance on Relay Chatter Effects*.

The ITS diesel generators will be started and sequenced to connect ITS loads as shown in SAR Figures 1.4.1-18 and 1.4.1-19. The load sequencer described in SAR Section 1.4.1.2.1 connects the Emergency Diesel Generator Facility loads first, followed by the Canister Receipt and Closure Facilities loads (1 through 3), and then the Wet Handling Facility loads.

The reliability requirements of the ITS power subsystem are provided in SAR Tables 1.9-3 and 1.9-4 for the Canister Receipt and Closure Facility and Wet Handling Facility ITS heating, ventilation, and air-conditioning systems. The design philosophy is that on loss of power, components fail in a safe condition: equipment motion stops and loads are retained. ITS components that fail-safe upon the loss of power are supplied by the normal (non-ITS) electrical power system. There are no impacts or collisions affecting a waste form container caused by a loss of power. Shield doors remain in position to protect facility workers from high radiation fields. Through the use of the national data in NUREG/CR-6890, *Loss of Offsite Power Events 1986-2004 Vol. I of Reevaluation of Station Blackout Risk at Nuclear Power Plants*, referenced in RAI 2.2.2.7-6-0001, the frequency of occurrence of a loss of offsite power with coincident breach of waste containers has been calculated to be beyond the Category 2 event sequence threshold (SAR Section 1.7). Reliability information is based on systems subject to industry codes and standards; therefore, setting thresholds for degraded voltage relays per codes is consistent with the reliability credited for estimates.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

IEEE Std 308-2001. 2002. *IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 252746.

IEEE Std 741-1997. 2002. *IEEE Standard Criteria for the Protection of Class 1E Power Systems and Equipment in Nuclear Power Generating Stations*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 255428.

NUREG/CR-5499, *Guidance on Relay Chatter Effects*.

NUREG/CR-6890 *Loss of Offsite Power Events 1986-2004 Vol. I of Reevaluation of Station Blackout Risk at Nuclear Power Plants*.

Regulatory Guide 1.6, Rev. 0. 1971. *Independence Between Redundant Standby (Onsite) Power Sources and Between Their Distribution Systems*. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 239115.

RAI Volume 2, Chapter 2.1.1.7, Sixth Set, Number 3:

The following questions pertain to DOE's design of the important-to-safety (ITS) Electric Power described in SAR Section 1.4.1. The ITS electric power supply is relied on for safety functions of structures, systems, and components, described in SAR Sections 1.2.3, 1.2.4, 1.2.5, 1.2.6, 1.2.8, 1.3.3, 1.4.1, and 1.4.2. The information requested below is needed to verify compliance with 10 CFR 63.112(f).

Provide information on methodology and criteria used for deciding which electrical loads are required to be powered by the ITS Electrical Power Supply.

In SAR Figures 1.4.1-12 and 1.4.1-13 for the ITS Electric Power Trains A & B, the applicant has shown the components not identified as ITS (e.g. non ITS Exhaust Fans and Lighting Panels) along with the ITS components. It is not clear why the components not identified as ITS are shown as powered by the ITS Electric Power.

1. RESPONSE

The methodology and criteria for determining which electrical loads are required to be powered by the important to safety (ITS) electrical power supply are discussed in SAR Sections 1.7 and 1.9.1.11. Structures, systems, and components (SSCs) are determined to be ITS if the SSCs are relied upon to prevent or mitigate an event sequence. In general, components associated with a support system function necessary for the proper functioning of ITS systems are classified as ITS. The classification of SSCs is addressed in SAR Section 1.9.1. The ITS power subsystem will provide power to ITS systems and equipment that require ITS power to perform a safety function in the event that the normal power source is lost, including the ITS heating, ventilation, and air-conditioning (HVAC) confinement systems. Immediate restoration of electrical power is not required to prevent or mitigate an event sequence since ITS SSCs are required to fail safe upon the loss of power. The ITS electrical subsystem also provides power to nonconfinement ITS HVAC equipment relied upon to cool and ventilate ITS electrical rooms, battery rooms, and systems supporting the operations of the ITS diesel generators. SAR Table 1.4.1-1 provides the design bases and design criteria for the ITS power subsystem SSCs for the Canister Receipt and Closure Facility (CRCF), the Wet Handling Facility (WHF), and the Emergency Diesel Generator Facility, which are based on the need to provide electrical power to the confinement and/or cooling HVAC system components for these facilities. The reliability of the ITS power subsystems is specified as a controlling parameter and value to reduce the probability of loss of ITS HVAC following a Category 2 event sequence.

The equipment and panels shown in SAR Figures 1.4.1-12 and 1.4.1-13 are ITS with the exception of the lighting panels. There are no non-ITS exhaust fans connected to ITS electrical busses; any component identified in SAR Figures 1.4.1-12 and 1.4.1-13 with a train designator is classified as ITS. SAR Figures 1.2.4-99 and 1.2.4-104 show the HVAC components in the CRCF that are designated as ITS and are connected to the ITS load centers and ITS motor control centers in the CRCF. Electrical isolation will be used to isolate the lighting panels from the ITS

power system in accordance with IEEE Std 308-2001, *Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations*; IEEE Std 384-1992, *Standard Criteria for Independence of Class 1E Equipment and Circuits*, and IEEE Std 603-1998, *IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations*. Electrically isolated, non-ITS lighting panels will be used to provide lighting within rooms housing ITS electrical equipment, ITS batteries, and ITS HVAC equipment. The non-ITS lighting panels also provide power to operator control rooms within the CRCF and WHF. The lighting panels do not require ITS power and are not relied upon to prevent or mitigate an event sequence. Appropriate isolation will assure that the integrity of ITS power is preserved; however, the use of isolated ITS power for the non-ITS lighting panels ensures a reliable power source for the operator control rooms and lighting in areas containing ITS electrical distribution equipment.

Additional information regarding the methodology and criteria used for supplying isolated power to the Receipt Facility is discussed in the response to RAI: 2.2.1.1.7-6-006.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

IEEE Std 308-2001. 2002. *IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations*. New York, New York: Institute of Electrical and Electronic Engineers. TIC: 252746.

IEEE Std 384-1992 (REAF 1998). *Standard Criteria for Independence of Class 1E Equipment and Circuits*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 258693.

IEEE Std 603-1998. *IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations*. New York, New York: The Institute of Electrical and Electronics Engineers. TIC: 242993.

RAI Volume 2, Chapter 2.1.1.7, Sixth Set, Number 4:

The following questions pertain to DOE's design of the important-to-safety (ITS) Electric Power described in SAR Section 1.4.1. The ITS electric power supply is relied on for safety functions of structures, systems, and components, described in SAR Sections 1.2.3, 1.2.4, 1.2.5, 1.2.6, 1.2.8, 1.3.3, 1.4.1, and 1.4.2. The information requested below is needed to verify compliance with 10 CFR 63.112(f).

Provide the following design-related information:

(a) Description of how ITS components and systems are designed within CRCF, WHF and EDGF to provide spatial diversity, independence, isolation, redundancy, single- failure criteria and other required characteristics of such wiring and connections within ITS facilities to meet the IEEE Codes referenced in SAR Section 1.4.1.5;

(b) Provide ITS electrical power requirements for ITS electrical power-dependent equipment in each ITS facility, which should include: (i) design criteria and design bases for total power utilization requirements and for sizing of total electrical power being made available to supply the loads for each main supply bus and for each distribution subsystem, and (ii) design criteria and design bases for any power supply sizing margins, for each facility containing ITS equipment;

(c) Provide design criteria and design bases for implementation of ITS Train A and Train B power connections to individual ITS loads within each facility. The information should include: (i) design criteria and design bases for physical diversity, redundancy, cooling, protection, independence, isolation, and other requirements for such power connections, and (ii) design criteria and design bases for power flow and control components (for example, relays, starters, variable speed drives, and other power controlling, switching, or protection components) involved in the connection or control of ITS power to end users within each facility;

(d) Ventilation requirements and design criteria for battery installations for DC power systems and battery-operated Uninterruptible Power Supply systems. The information should include design criteria or design information to support the conclusion made in SAR Section 1.2.4, in which the applicant stated that adequate ventilation is provided to prevent the buildup of explosive atmospheres in battery rooms;

(e) Clarification on whether the provision of the adequate ventilation, delineated in (d) above, is applied to: (i) 125V DC power systems and Uninterruptible Power Supply systems, (ii) which facilities, and (iii) ITS electrical power systems and normal electrical power and ITS electrical power systems; and

(f) Location, housing, cooling, physical protection, and separation/single-failure design of the ITS 13.8kV transformers (trains A & B) for the CRCF and WHF.

1. RESPONSE

1.1 PROVIDE A DESCRIPTION OF HOW ITS COMPONENTS AND SYSTEMS ARE DESIGNED TO PROVIDE SPATIAL DIVERSITY, INDEPENDENCE, ISOLATION, REDUNDANCY, AND SINGLE-FAILURE CRITERIA

(a) Description of how ITS components and systems are designed within CRCF, WHF and EDGF to provide spatial diversity, independence, isolation, redundancy, single-failure criteria and other required characteristics of such wiring and connections within ITS facilities to meet the IEEE Codes referenced in SAR Section 1.4.1.5;

The preclosure safety analysis (PCSA) identified the important to safety (ITS) electrical components in the Canister Receipt and Closure Facility (CRCF), Wet Handling Facility (WHF), and Emergency Diesel Generator Facility (EDGF), their safety functions, and the associated controlling parameters and values. A description of the PCSA analyses is provided in the response to RAI 2.2.1.1.7-5-002. The use of the single-failure criterion in the design of the ITS electrical power system is described in RAI 2.2.1.1.7-6-009. The nuclear safety design bases for ITS electrical structures, systems, and components (SSCs) are described within SAR Section 1.9 (Tables 1.9-3 and 1.9-4). ITS electrical SSCs are listed at a high level of assembly (e.g., ITS direct current power supply). The safety function and the controlling parameters and values are also listed for the ITS electrical power system.

The ITS power subsystem consists of two independent and physically separated ITS diesel generators, each with associated 13.8-kV ITS switchgear and ITS electrical distribution equipment (SAR Section 1.4.1.2.1). The ITS diesel generators are located in the EDGF (SAR Section 1.2.8). The two ITS 13.8-kV trains are independent and redundant; one train is adequate to satisfy the safety requirements listed in SAR Table 1.4.1-1. The ITS diesel generators and ITS Trains A and B are electrically isolated from each other. Physical separation for fire and missile protection is provided between each ITS diesel generator in the EDGF and each ITS electrical room in the CRCF and WHF, as they are housed in separate rooms in the respective facility. The ITS loads supplied by the train-oriented ITS power subsystem are also located in physically separated, train-oriented equipment rooms on opposite sides of the facilities. Power and control cables for the ITS diesel generators and ITS Trains A and B electrical distribution equipment are installed in separate conduits, cable trays, or ducts and routed to maintain physical separation throughout the EDGF, CRCF, and WHF. The redundant and independent ITS buses in the EDGF, CRCF, and WHF allow maintenance to be performed on the ITS equipment of one train while the ITS equipment of the other train remains in service.

SAR Section 1.4.1.5 provides generally applicable nuclear industry codes and standards used for the design of both ITS and non-ITS electrical power systems. Using the methods and practices of the codes and standards identified in SAR Section 1.4.1.2.8, the repository's ITS electrical SSCs are expected to perform at the reliability required by the nuclear safety design bases. The

fundamental acceptance criteria for the ITS power subsystem is the reliability of the power supply and distribution to the ITS HVAC functions. Typical IEEE Class 1E separation practices are expected to deliver the required reliability. However, in detailed design, it may be identified that the specific aspects of implementation may need to be adjusted to achieve the desired reliability. Any additional, or lesser, separation, redundancy, or diversity will be evaluated by the PCSA and demonstrated to be acceptable.

1.2 PROVIDE ITS ELECTRICAL POWER REQUIREMENTS FOR ITS ELECTRICAL POWER-DEPENDENT EQUIPMENT IN EACH ITS FACILITY

- (b) Provide ITS electrical power requirements for ITS electrical power-dependent equipment in each ITS facility, which should include: (i) design criteria and design bases for total power utilization requirements and for sizing of total electrical power being made available to supply the loads for each main supply bus and for each distribution subsystem, and (ii) design criteria and design bases for any power supply sizing margins, for each facility containing ITS equipment;

The design criteria and design bases for total power utilization and sizing requirements are based on NFPA 70-2005, *National Electrical Code* and IEEE Std 241-1990, *IEEE Recommended Practice for Electric Power Systems in Commercial Buildings*. The ITS electrical power requirements for each facility containing ITS equipment are determined from the total demand loads on the system including sufficient margin to accommodate future growth. The total demand loads consist of specific loads and lumped loads. Specific loads refer to expected electrical demands from systems and equipment that require an ITS power supply (e.g., ITS heating, ventilation, and air-conditioning (HVAC)). Lumped loads refer to general electrical demands inherent in building operation.

Loads that are specific to each facility are determined from design information relevant to the system requiring ITS power (e.g., ventilation and instrumentation diagrams). Specific loads in kW are converted to kVA by dividing by the power factor, conservatively taken to be 80%. In accordance with NFPA 70-2005, an additional factor of 25% is applied to the largest motor load on each motor control center, and/or load center, to determine the total calculated load.

Lumped loads are used to approximate the power demands of lighting and general receptacles associated with each ITS electrical train. NFPA 70-2005 specifies the power density for lighting, and IEEE Std 241-1990 specifies the power density for receptacle loads. Area-specific lumped loads (connected loads) are determined by multiplying the code-specified power density with the square footage of each ITS area to obtain apparent power. In accordance with NFPA 70-2005, an additional factor of 25% is applied to the apparent power for continuous loads (e.g., lighting). Refer to response RAI 2.2.1.1.7-6-003 for the basis of isolating and supplying non-ITS components (lighting and power) from an ITS bus structure.

Each connected load that results from specific loads, or lumped loads, is multiplied by a demand factor to calculate the demand load. When two noncoincidental loads are in use simultaneously, only the largest load is used for calculating the total load. Because ITS operating and standby

ITS loads are on the same ITS bus, the ITS operating load has a demand factor of 1.00 and the ITS standby load has a demand factor of 0.00.

The ITS electrical system is designed to accommodate sufficient margin for future growth. To account for future growth, a margin factor is applied to the demand loads to calculate the spare capacity. The attached Table 1 summarizes the margin factor for each ITS electrical component and whether the margin should be applied at the time of procurement or commissioning.

The required capacity for each load is calculated by adding the demand load and the spare capacity and dividing by the diversity factor, conservatively taken to be 1.00. The total load capacity required for each facility ITS component (e.g., transformer, load center, motor control center) is then calculated by summing the required capacities of the connected equipment within the component hierarchical system. The attached Table 2 presents the approximate total load for each major piece of ITS distribution equipment within the WHF, CRCF, and EDGF. As the design matures, each facility load is expected to change slightly to accommodate actual equipment loads. The final step in sizing the electrical components is based on selecting the next size up in standard ratings of equipment which inherently builds in additional design margin. For example, Table 2 shows the CRCF ITS Facility Transformer – Train A 13.8 kV-480 V, equipment number 060-EEE0-XFMR-00001, with a design capacity of 522 kVA, and SAR Figure 1.4.1-13 shows the transformer sized at 750kVA (the next standard size available), which equates to approximately another 43% of design margin.

1.3 PROVIDE DESIGN CRITERIA AND DESIGN BASES FOR IMPLEMENTATION OF ITS POWER CONNECTIONS TO INDIVIDUAL ITS LOADS

- (c) Provide design criteria and design bases for implementation of ITS Train A and Train B power connections to individual ITS loads within each facility. The information should include: (i) design criteria and design bases for physical diversity, redundancy, cooling, protection, independence, isolation, and other requirements for such power connections, and (ii) design criteria and design bases for power flow and control components (for example, relays, starters, variable speed drives, and other power controlling, switching, or protection components) involved in the connection or control of ITS power to end users within each facility;

The selection of power flow and control components (e.g., relays, control switches, starters, adjustable speed drives or other protection components) will be completed during the detailed design stage and consistent with similar applications in the nuclear industry. The nuclear safety design bases for the ITS electrical power system were developed from the PCSA and are found in SAR Section 1.9. A description of the PCSA analyses is provided in the response to RAI 2.2.1.1.7-5-002. Using the codes and standards cited in SAR Section 1.4.1.2.8, provides confidence that when operation begins, SSC reliability will fall within the estimates used in the PCSA. Unless an exception applies as a result of the PCSA, this design includes the characteristics of spatial diversity, independence, isolation, redundancy and single-failure protection for ITS Train A and Train B power. The design also includes power flow and control components for connection and control of ITS power to the end users within each facility.

1.4 PROVIDE VENTILATION REQUIREMENTS AND DESIGN CRITERIA FOR BATTERY INSTALLATIONS

- (d) Ventilation requirements and design criteria for battery installations for DC power systems and battery-operated Uninterruptible Power Supply systems. The information should include design criteria or design information to support the conclusion made in SAR Section 1.2.4, in which the applicant stated that adequate ventilation is provided to prevent the buildup of explosive atmospheres in battery rooms;

The principal design criteria used to determine ventilation requirements for battery installations of the direct current (DC) power systems and battery-operated uninterruptible power supply (UPS) systems are ASHRAE-2007, *ASHRAE® Handbook, Heating, Ventilating, and Air-Conditioning Applications*; NFPA 70-2005, Section 480.9 (A); and IEEE Std 484-2002, *IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications* IEEE Std 484-2002, Section 5.4, and ASHRAE-2007, page 26.9, recommend hydrogen concentration in battery rooms to be 2% or less of the room volume, and additionally states that if battery design information is not available, then the exhaust system should be designed to provide a minimum of five air changes per hour (ACH) to preclude accumulation of hydrogen such that it is below the lower explosive limit. The attached Table 3 summarizes the ACH for the ITS battery rooms located in the CRCF, WHF and EDGF. In all three facilities, the number of ACH is substantially above the ASHRAE-2007 and IEEE Std 484 minimum requirements.

For the CRCF, SAR Figure 1.2.4-104 shows the composite ventilation flow diagram, and SAR Figures 1.2.4-105 through 1.2.4-108 show the ventilation and instrumentation diagrams for the ITS HVAC subsystems serving the ITS electrical equipment and battery rooms. For the WHF, SAR Figure 1.2.5-87 shows the composite ventilation flow diagram, and SAR Figures 1.2.5-88 to 1.2.5-91 show the ventilation and instrumentation diagrams for the ITS HVAC subsystems serving ITS electrical equipment and battery rooms. SAR Figures 1.2.4-109 and 1.2.4-110 show the CRCF and WHF ITS electrical room fan coil unit (Trains A and B) logic diagram. SAR Figure 1.2.4-111 shows the CRCF and WHF ITS battery room exhaust fan (Trains A and B) logic diagram. The ventilation flow diagram for both trains of the EDGF nonconfinement switchgear and battery rooms is shown in SAR Figure 1.2.8-26. The EDGF nonconfinement battery room exhaust fan logic diagram is shown in SAR Figure 1.2.8-34.

Battery installations for DC power systems and UPS systems are designed using the methods and practices of the principal codes and standards applicable to batteries as shown in the attached Table 4.

1.5 PROVIDE CLARIFICATION ON WHICH SYSTEMS AND FACILITIES THE PROVISIONS OF ADEQUATE VENTILATION APPLY

- (e) Clarification on whether the provision of the adequate ventilation, delineated in (d) above, is applied to: (i) 125V DC power systems and Uninterruptible Power Supply systems, (ii) which facilities, and (iii) ITS electrical power systems and normal electrical power and ITS electrical power systems; and

The provision of adequate ventilation, delineated in (d) above, is applied to the 125V DC power systems, UPS systems, ITS electrical power systems and normal electrical power within the CRCF, EDGF, and WHF as well as the Low-Level Waste Facility, Initial Handling Facility, Receipt Facility and Central Control Center Facility.

The design criteria for limiting hydrogen concentration and providing a minimum number ACH applies to all battery systems in the repository, irrespective of safety classification, voltage level or facility location.

1.6 PROVIDE THE LOCATION, HOUSING, COOLING, PHYSICAL PROTECTION, AND SEPARATION OF THE ITS TRANSFORMERS FOR THE CRCF AND WHF

- (f) Location, housing, cooling, physical protection, and separation/single-failure design of the ITS 13.8kV transformers (trains A & B) for the CRCF and WHF.

The ITS power subsystem consists of two independent and physically separated A and B power trains. The ITS 13.8kV / 480V Train A and B transformers for the CRCF and the WHF are housed in two separate ITS electrical rooms within the CRCF (Rooms 1008 and 1029) and WHF (Rooms 1002 and 1019) ITS structures. The ITS electrical rooms provide physical separation, isolation and protection of the 13.8kV ITS transformers and associated ITS electrical components. ITS and non-ITS power systems are separated and isolated such that failure in the non-ITS system will not impact the ITS system.

For the CRCF, the ITS Train A 13.8kV transformer, equipment number 060-EEE0-XFMR-00001, from SAR Figure 1.4.1-12, is located in the center of Room 1008 and shown in SAR Figure 1.2.4-2. The associated ITS Train A load center, equipment number 060-EEE0-LC-00001, is also located in the center of Room 1008 beside the ITS Train A 13.8kV transformer. The associated ITS motor control center, equipment number 060-EEE0-MCC-00001, is located along the west wall of Room 1008. The CRCF ITS Train B 13.8kV transformer, ITS load center, and ITS motor control center are located in Room 1029 of SAR Figure 1.2.4-2 with an orientation similar to Train A.

For the WHF, the ITS Train A 13.8kV transformer from SAR Figure 1.4.1-14 is located on the west side of Room 1002 and shown in SAR Figure 1.2.5-2. The associated ITS Train A load center is located beside the ITS Train A 13.8kV transformer, and the ITS motor control center is located in the center of Room 1002. Similar WHF Train B ITS electrical components are located in Room 1019.

The ITS Train A and B 13.8kV transformers are dry-type without forced-air cooling. The cooling of the ITS electrical rooms is a function of the train-orientated nonconfinement ITS

HVAC system. The preclosure nuclear safety design bases for the CRCF and WHF nonconfinement ITS HVAC systems are provided in SAR Tables 1.9-3 and 1.9-4, respectively.

The ITS A and B Trains are electrically isolated and separated from each other within each facility. The ITS transformers are protected from external hazards by the concrete walls and roof structure of the CRCF and WHF. Each of the ITS 13.8kV transformers is independent and redundant; one train is adequate to satisfy the safety requirements. Cables associated with each ITS power train are run in separate conduits, cable trays, or ducts. Additional single-failure design criteria are discussed in the response to RAI 2.2.1.1.7-6-009.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

ASHRAE (American Society of Heating, Refrigerating & Air-Conditioning Engineers) 2007. *2007 ASHRAE® Handbook, Heating, Ventilating, and Air-Conditioning Applications*. Inch-Pound Edition. Atlanta, Georgia: American Society of Heating, Refrigerating and Air-Conditioning Engineers. TIC: 260028.

BSC (Bechtel SAIC Company) 2007. *Project Design Criteria Document*. 000-3DR-MGR0-00100-000-007. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20071016.0005.

IEEE Std 241-1990, Reaffirmed 1997. 1998. *IEEE Recommended Practice for Electric Power Systems in Commercial Buildings*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 255956.

IEEE Std 484-2002. 2003. *IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 256025.

NFPA 70. 2005. *National Electrical Code*. 2005 Edition. Quincy, Massachusetts: National Fire Protection Association. TIC: 258735.

Table 1. ITS Electrical Power Component Margin

ITS Electrical Component	Margin (%)	Load Growth / Spare Capacity	At Procurement / Commissioning
Panelboards	25	Load Growth	Procurement
Transformers	25	Spare Capacity	Procurement
Medium-Voltage Switchgear	25	Load Growth	Procurement
Lighting and Instrumentation Transformers	25	Spare Capacity	Procurement
Load Center	25	Load Growth	Procurement
Motor Control Center	25	Load Growth	Procurement
Battery Systems	25	Spare Capacity	Commissioning
Uninterruptible Power Supplies	25	Spare Capacity	Procurement
Diesel Generators	15	Spare Capacity	Procurement
Cable Trays	25	Load Growth	Procurement

Source: *Project Design Criteria Document* (BSC 2007, Section 4.3).

Table 2. Total Load for Each Major Piece of ITS Distribution Equipment

Component ID	Distribution Equipment	Estimated Total Load (kVA)
050-EEE0-XFMR-00001	WHF ITS Facility Transformer – Train A 13.8 kV-480 V	508
050-EEE0-XFMR-00002	WHF ITS Facility Transformer – Train B 13.8 kV-480 V	508
050-EEE0-LC-00001	WHF 480 V ITS Load Center – Train A	508
050-EEE0-LC-00002	WHF 480 V ITS Load Center – Train B	508
050-EEE0-MCC-00001	WHF 480 V ITS Motor Control Center – Train A	195
050-EEE0-MCC-00002	WHF 480 V ITS Motor Control Center – Train B	195
060-EEE0-XFMR-00001	CRCF ITS Facility Transformer – Train A 13.8 kV-480 V	522
060-EEE0-XFMR-00002	CRCF ITS Facility Transformer – Train B 13.8 kV-480 V	522
060-EEE0-LC-00001	CRCF 480 V ITS Load Center – Train A	522
060-EEE0-LC-00002	CRCF 480 V ITS Load Center – Train B	522
060-EEE0-MCC-00001	CRCF 480 V ITS Motor Control Center – Train A	210
060-EEE0-MCC-00002	CRCF 480 V ITS Motor Control Center – Train B	210
26D-EEE0-XFMR-00001	EDGF ITS Facility Transformer – Train A 13.8 kV-480 V	476
26D-EEE0-XFMR-00002	EDGF ITS Facility Transformer – Train B 13.8 kV-480 V	476
26D-EEE0-MCC-00001	EDGF 480 V ITS Motor Control Center – Train A	476
26D-EEE0-MCC-00002	EDGF 480 V ITS Motor Control Center – Train B	476

Table 3. ITS Battery Room Air Changes

Facility	ITS Battery Room Volume in ft ³ (Approximate)	Equipment Exhaust Capacity in cfm/unit	Air Change per Hour (Approximate)
CRCF	2760 (230 ft ² x12 ft h) SAR Fig. A-22	1000 SAR Table-1.2.4-7	21
WHF	2760 (230 ft ² x12 ft h) SAR Fig. A-39	1000 SAR Table-1.2.5-4	21
EDGF	1200 (120 ft ² x10 ft h) SAR Fig. A-84	450 SAR Table-1.2.8-4	22

NOTE: cfm = cubic feet per minute.

Table 4. Principal Codes and Standards Applicable to Batteries

Codes and Standards	Applicability
ASME AG-1a-2004, 2005, <i>Addenda to ASME AG-1-2003, Code on Nuclear Air and Gas Treatment</i>	HVAC system
ASHRAE- 2007, <i>ASHRAE Handbook, Heating, Ventilating, and Air-Conditioning Applications.</i>	HVAC system
DOE-HDBK-1169-2003, <i>Nuclear Air Cleaning Handbook</i>	HVAC system
IEEE Std 446-1995, <i>IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications</i>	UPS systems
IEEE Std 450-2002, <i>IEEE Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications</i>	Maintenance and testing of battery systems
IEEE Std 484-2002, 2003, <i>IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications</i>	Lead Storage Batteries
IEEE Std 485-1997 (R2003), <i>IEEE Recommended Practice for Sizing Lead-Acid Batteries for Stationary Applications</i>	Sizing battery systems
IEEE Std 535-1986, <i>IEEE Standard for Qualification of Class 1E Lead Storage Batteries for Nuclear Power Generating Stations</i>	Qualification of ITS lead storage batteries
IEEE Std 650-2006, <i>IEEE Standard for Qualification of Class 1E Static Battery Chargers and Inverters for Nuclear Power Generating Stations</i>	Maintenance and surveillance of ITS components
IEEE Std 946-2004, <i>IEEE Recommended Practice for the Design of DC Auxiliary Power Systems for Generating Stations</i>	Protective relaying and medium-voltage switchgear control
IEEE Std 1115-2000 (R2005), <i>IEEE Recommended Practice for Sizing Nickel-Cadmium Batteries for Stationary Applications</i>	Sizing battery systems
IEEE Std 1184-1994 (R1995), <i>IEEE Guide for the Selection and Sizing of Batteries for Uninterruptible Power Systems</i>	UPS sizing and selection for ITS applications
IEEE Std 1188-2005, <i>IEEE Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications</i>	Maintenance and testing of valve-regulated lead-acid battery systems
IEEE Std 1189-1996, <i>IEEE Guide for Selection of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications</i>	Selection of valve-regulated lead-acid batteries
NFPA 70, <i>National Electrical Code</i>	Design, installation and maintenance of battery systems
Regulatory Guide 1.129, <i>Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Nuclear Power Plants</i>	Maintenance and surveillance of ITS components
Regulatory Guide 1.158, 1989, <i>Qualification of Safety-Related Lead Storage Batteries for Nuclear Power Plants</i>	Qualification of ITS lead storage batteries

Source: *Project Design Criteria Document (BSC 2007).*

RAI Volume 2, Chapter 2.1.1.7, Sixth Set, Number 5:

The following questions pertain to DOE's design of the important-to-safety (ITS) Electric Power described in SAR Section 1.4.1. The ITS electric power supply is relied on for safety functions of structures, systems, and components, described in SAR Sections 1.2.3, 1.2.4, 1.2.5, 1.2.6, 1.2.8, 1.3.3, 1.4.1, and 1.4.2. The information requested below is needed to verify compliance with 10 CFR 63.112(f).

Provide information on the criteria used for the design of the ITS electrical power supply for the surface facility non-confinement HVAC system designed to cool and ventilate electrical and battery rooms in the EDGF.

Criteria for required performance of ITS electrical power supplies for ITS surface facility confinement HVAC systems designed for cooling and ventilation of electrical equipment and battery rooms in the CRCF and WHF are included in SAR Table 1.4.1-1. Criteria for performance of portions of surface non-confinement HVAC systems designed to provide cooling and ventilation of electrical equipment and battery rooms in the EDGF are included in SAR Tables 1.9.3 and 1.9.4. However, the criteria for required performance of ITS electrical power supplies, which provide power to portions of surface non-confinement HVAC systems, are not provided.

1. RESPONSE

The design criteria used for the important to safety (ITS) power subsystem for the ITS surface nonconfinement heating, ventilating, and air-conditioning (HVAC) system designed to cool and ventilate electrical and battery rooms in the Emergency Diesel Generator Facility (EDGF) are applicable to both the ITS surface nuclear confinement HVAC systems and surface ITS nonconfinement HVAC systems. The electrical criteria (e.g., EE.CR.01) are applicable to the entire ITS power subsystem; there are no separate criteria for the ITS power subsystem to the nonconfinement HVAC system. The HVAC criteria in SAR Table 1.9-3 for the confinement and nonconfinement systems (e.g., VC.CR.02 and VN.CR.01, respectively) are identical, supporting the use of one set of electrical criteria for both systems.

The criteria for required performance of the reliability of the ITS power subsystem are stated in SAR Table 1.4.1-1 and are based upon continuity of filtration to mitigate an event sequence involving a load drop, breach, and release of radioactivity. The required reliability of the ITS power subsystem to the ITS cooling units in the Canister Receipt and Closure Facility (CRCF), the Wet Handling Facility (WHF), and the EDGF are the same as the controlling parameters and values for EE.CR.01, EE.CR.02, EE.WH.01, EE.WH.02, and EE.WH.03. The design of the ITS power subsystem for the surface nonconfinement HVAC in the EDGF is described in SAR Sections 1.4.1.2 and 1.4.1.3.

ENCLOSURE 5

Response Tracking Number: 00350-00

RAI: 2.2.1.1.7-6-005

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

RAI Volume 2, Chapter 2.1.1.7, Sixth Set, Number 6:

The following questions pertain to DOE's design of the important-to-safety (ITS) Electric Power described in SAR Section 1.4.1. The ITS electric power supply is relied on for safety functions of structures, systems, and components, described in SAR Sections 1.2.3, 1.2.4, 1.2.5, 1.2.6, 1.2.8, 1.3.3, 1.4.1, and 1.4.2. The information requested below is needed to verify compliance with 10 CFR 63.112(f).

Provide additional information to clarify what ITS functions require ITS electrical power in the Receipt Facility (RF). SAR Figures 1.4-10 and 1.4-11 show ITS power feeder for the RF; however, ITS power distribution and loads for the RF are not reflected in the balance of the SAR.

1. RESPONSE

The safety classification of the electrical power subsystem and any associated loads in the Receipt Facility (RF) is not important to safety (non-ITS). SAR Table 1.9-5, "Preclosure Nuclear Safety Design Bases for RF ITS SSCs," identifies no ITS functions within the RF requiring ITS electrical power. The preclosure safety analysis identified no Category 1 or 2 event sequences in the RF.

The electrical design for the RF follows the same approach as the electrical design of the Canister Receipt and Closure Facility and the Wet Handling Facility, resulting in a facility electrical design with normal power and two separate A and B trains. However, because the RF heating, ventilation, and air conditioning has no ITS confinement or ITS cooling functions, the connection of the RF feeder to the Train A and B ITS 13.8 kV buses is provided with electrical isolation devices; thereby, changing the safety classification of the RF feeder to non-ITS on the secondary side of the electrical isolation device as shown in SAR Figures 1.4.1-10 and 1.4.1-11. Electrical isolation for the RF non-ITS power system is in accordance with IEEE Std 308-2001, *Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations*; IEEE Std 384-1992, *Standard Criteria for Independence of Class 1E Equipment and Circuits*; and IEEE Std 603-1998, *IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations*. The ITS load sequencer shown in SAR Figures 1.4.1-18 and 1.4.1-19 does not automatically load the RF. The electrical design provides isolation and the ability to manually transfer power from the ITS bus to the RF.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

IEEE Std 308-2001. 2002. *IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations*. New York, New York: Institute of Electrical and Electronic Engineers. TIC: 252746.

IEEE Std 384-1992. 1998. *Standard Criteria for Independence of Class 1E Equipment and Circuits*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 258693.

IEEE Std 603-1998. *IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations*. New York, New York: The Institute of Electrical and Electronics Engineers. TIC: 242993.

RAI Volume 2, Chapter 2.1.1.7, Sixth Set, Number 7:

The following questions pertain to DOE's design of the important-to-safety (ITS) Electric Power described in SAR Section 1.4.1. The ITS electric power supply is relied on for safety functions of structures, systems, and components, described in SAR Sections 1.2.3, 1.2.4, 1.2.5, 1.2.6, 1.2.8, 1.3.3, 1.4.1, and 1.4.2. The information requested below is needed to verify compliance with 10 CFR 63.112(f).

Justify the exclusion of the EDGF Uninterruptible Power Supply from ITS Electrical Power Supply reliability calculations.

A SAR reference, "*CRCF Reliability and Event Sequence Categorization Analysis*, Section B8.2.2," includes a statement that the EDGF Uninterruptible Power Supply supports the ITS diesel generator control systems. During a LOSP event, this function provides electrical power needed instrumentation and controls for automatic startup and loading of the ITS EDGs and other related functions.

1. RESPONSE

As stated in *Canister Receipt and Closure Facility Reliability and Event Sequence Categorization Analysis* (BSC 2008, Section B8.2.2), the Emergency Diesel Generator Facility uninterruptible power supply (UPS) was not modeled because UPS systems are historically reliable and would, even if included, negligibly change the important to safety (ITS) AC electrical power supply failure probability.

The event sequence categorization analysis shows the failure rate for a UPS as 2×10^{-6} per hour (BSC 2008, Attachment C, Table C4-1). Because of multiple means to detect such a failure, the exposure time is taken as 168 hours (BSC 2008, Section B.8.4.1.5), leading to an average UPS unavailability of 3×10^{-4} . If UPS failure would have been explicitly modeled in the fault trees, it would have appeared only in cut sets that are homomorphic to (i.e., have the same form as) cut sets that include ITS diesel generator failure to start given a loss of normal electrical power. There are five such cut sets. If the above UPS unavailability is substituted for ITS diesel generator failure to start in these five cut sets, then the UPS power would contribute approximately 4×10^{-6} to the unavailability of a train of the ITS power subsystem. As noted in Figures B8.4-1 and B8.4-3 of the event sequence categorization analysis (BSC 2008), the point estimate for the unavailability of a train of the ITS power subsystem is 3×10^{-2} . Therefore, ITS power subsystem unavailability would be more than three orders of magnitude higher than cut sets associated with UPS unavailability, which makes UPS a negligible contributor to the total.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

BSC (Bechtel SAIC Company) 2008. *Canister Receipt and Closure Facility Reliability and Event Sequence Categorization Analysis*. 060-PSA-CR00-00200-000-00A. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20080311.0031.

RAI Volume 2, Chapter 2.1.1.7, Sixth Set, Number 8:

Clarify why, for the design of the ITS Diesel Generators, DOE has made reference in Section 1.4.1.5 to the regulatory positions of NRC Regulatory Guide 1.9 Rev. 3, 1993 which endorses an old version of industry standard IEEE 387-1984, instead of the current version of Regulatory Guide 1.9 (Rev. 4, March 2007), which endorses IEEE Standard 387-1995.

In its explanation in SAR Section 1.4.1.2.8, DOE attempts to clarify where IEEE 387 versions are used, however there are regulatory positions affecting testing and other requirements in the current version of Regulatory Guide 1.9 which have not been addressed. SAR Section 1.4.1.5 makes reference to both versions of IEEE Standard 387 (i.e., both the 1984 version and the 1995 version, but only Rev. 3 of Regulatory Guide 1.9).

1. RESPONSE

The design of the important to safety (ITS) diesel generators will be in accordance with IEEE Std 387-1995, *Standard Criteria for Diesel-Generator Units Applied as Standby Power Generating Stations*, as stated in SAR Section 1.4.1.2.8, *Design Codes and Standards for AC and DC ITS Electrical Power*. Revision 4 of Regulatory Guide 1.9, *Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants*, will be utilized in the design and testing of ITS diesel generators at the Yucca Mountain repository except for the five inapplicable conditions described below.

There are basic differences between the Yucca Mountain repository and a commercial nuclear power reactor for which Regulatory Guide 1.9 was written. The clarifications between the repository design and Regulatory Guide 1.9 are provided in SAR Section 1.4.1.2.8; which states, the design of the ITS power system is in accordance with IEEE Std 387-1995 instead of IEEE Std 387-1984. The justification for referencing IEEE Std 387-1984 in SAR Section 1.4.1.5, is the editing practice of providing full bibliographic citations for documents cited in the text. The following five paragraphs provide additional clarification of SAR Section 1.4.1.2.8 and Regulatory Guide 1.9, Rev. 4.

- 1) There is no requirement for the ITS diesel generators to start and accept load within 10 seconds. The frequency of an event sequence that includes both loss of offsite power and a breach of a waste container is below the Category 2 lower threshold (SAR Section 1.7.1.3) as determined by the preclosure safety analysis (PCSA) and the reliability of load handling equipment to hold loads for 30 days without electric power. In the event of loss of offsite power, the non-ITS equipment shuts down or moves to the fail safe position and the ITS exhaust fans stop running. During the period of time while the ITS diesel generators start and the ITS exhaust fans are loaded on the ITS electrical busses, the ITS confinement areas are effectively isolated and there is negligible driving force to disperse potential radioactive material. Once the ITS exhaust fans are running, filtration of exhaust air can continue. The PCSA will determine the ITS diesel generator start times based upon facility safety functions.

- 2) There is no safety injection actuation signal; therefore, the protective trip bypass test and test mode change-over test are not applicable. The safety injection actuation signal test and the combined safety injection actuation signal and loss of offsite power test will be addressed by demonstrating that the ITS diesel generators can satisfactorily respond to a loss of offsite power event through evaluation of specific repository blackout duration capability, as determined by the PCSA.
- 3) Under a loss of offsite power or degraded voltage, the 13.8 kV normal power supply breakers are tripped and the ITS diesel generators are started.
- 4) There is no refueling outage at the repository; however, the ITS diesel generators will be periodically tested.
- 5) Reporting requirements will be in accordance with 10 CFR Part 21 and 10 CFR 63.73.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

IEEE Std 387-1995. 2001. *Standard Criteria for Diesel-Generator Units Applied as Standby Power Generating Stations*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 258750.

Regulatory Guide 1.9, Rev. 4. 2007, *Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants*. Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20071219.0041.

RAI Volume 2 Chapter 2.1.1.7, Sixth Set, Number 9:

The following questions pertain to DOE's design of the important-to-safety (ITS) Electric Power described in SAR Section 1.4.1. The ITS electric power supply is relied on for safety functions of structures, systems, and components, described in SAR Sections 1.2.3, 1.2.4, 1.2.5, 1.2.6, 1.2.8, 1.3.3, 1.4.1, and 1.4.2. The information requested below is needed to verify compliance with 10 CFR 63.112(f).

Clarify the use (or non-use) of Single-Failure criteria in the design of the ITS electrical power system.

The list of specific references for the ITS electric power system provided in SAR Section 1.4.1.2.8 does not directly include references to a Single-Failure Criterion as a basis for the design of the system. The list of general references provided in SAR Section 1.4.1.5 does, however, include a reference to an IEEE Std 379-2000. 2001 Standard, *Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems*. It is not clear if the applicant's ITS electrical power system design described in the SAR meets the single-failure criterion. Staff needs the information to verify compliance with 10 CFR 63.21(c) (3) (ii).

1. RESPONSE

Single-failure has not been applied as a design criterion, based on the application of a risk informed performance based preclosure safety analysis (PCSA). However, because the design features inherent in the single-failure approach provide for reliable operations, DOE is following those approaches in its design process. Therefore, IEEE Std 379-2000, *IEEE Standard Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems* has been applied to the design of the important to safety (ITS) electrical power system as a means of achieving the system reliability required to meet the PCSA nuclear safety design bases. ITS structures, systems, and components (SSCs) are designed to fail-safe on loss of power. For ITS confinement and cooling functions of the ITS heating, ventilation, and air-conditioning systems within the Emergency Diesel Generator Facility, Canister Receipt and Closure Facility, and the Wet Handling Facility, two redundant trains of ITS mechanical equipment are supplied with ITS power from two (Trains A and B) redundant, electrically isolated and physically separated ITS diesel generators designed to comply with the single-failure criterion of IEEE Std 379-2000. IEEE Std 379-2000 is not applicable to the normal (non-ITS) power system supplying power to ITS SSCs (e.g., cranes, gates, doors, interlocks, sensors, switches) as these ITS SSCs do not require ITS power to perform their ITS functions.

For additional discussion of the DOE risk-informed approach to the development of nuclear safety design bases and the development of design criteria, see the response to RAI 2.2.1.1.7-6-004, parts (a) and (c).

The list of specific references for the ITS electrical power system provided in SAR Section 1.4.1.2.8 includes IEEE Std 308-2001, *Standard Criteria for Class 1E Power Systems for*

Nuclear Power Generating Stations, and IEEE Std 603-1998, *IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations*, both of which apply the single-failure criterion and invoke IEEE Std 379-2000 as a means to provide for reliable operations. Section 4.3.2.4 of the *Project Design Criteria Document* (BSC 2007) requires the ITS power subsystem to be designed in accordance with IEEE Std 379-2000.

2. COMMITMENTS TO NRC

None.

3. DESCRIPTION OF PROPOSED LA CHANGE

None.

4. REFERENCES

IEEE Std 308-2001. 2002. *IEEE Standard Criteria for Class 1E Power Systems for Nuclear Power Generating Stations*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 252746.

IEEE Std 379-2000. 2001. *IEEE Standard Application of the Single-Failure Criterion to Nuclear Power Generating Station Safety Systems*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 255427.

IEEE Std 603-1998. *IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations*. New York, New York: Institute of Electrical and Electronics Engineers. TIC: 242993.

BSC (Bechtel SAIC Company) 2007. *Project Design Criteria Document*. 000-3DR-MGR0-00100-000-007. Las Vegas, Nevada: Bechtel SAIC Company. ACC: ENG.20071016.0005.